US006978332B1

(12) **United States Patent**
Harris et al.

(10) **Patent No.: US 6,978,332 B1**
(45) **Date of Patent: Dec. 20, 2005**

(54) **VXS MULTI-SERVICE PLATFORM SYSTEM WITH EXTERNAL SWITCHED FABRIC LINK**

(75) Inventors: **Jeffrey M. Harris**, Chandler, AZ (US); **Robert C. Tufford**, Chandler, AZ (US)

(73) Assignee: **Motorola, Inc.**, Schaumburg, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 36 days.

(21) Appl. No.: **10/884,414**

(22) Filed: **Jul. 2, 2004**

(51) **Int. Cl.**[7] **G06F 13/00**; G06F 3/00
(52) **U.S. Cl.** **710/300**; 710/2; 710/301
(58) **Field of Search** 710/300–301, 710/316–317, 305, 2, 38; 370/351, 360, 362, 370/396; 709/217–218

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,488,541	A *	1/1996	Mistry et al.	361/788
6,526,446	B1 *	2/2003	Yang et al.	709/230
2002/0077112	A1 *	6/2002	McIntosh et al.	455/453
2003/0051088	A1 *	3/2003	Ho et al.	710/300
2003/0236920	A1 *	12/2003	Harris et al.	709/253
2004/0078506	A1 *	4/2004	Wong et al.	710/301

OTHER PUBLICATIONS

Hosking, Rodger. "VXS: Switched Serial Gigabit Fabric for VMEbus." TechOnLine. Sep. 23, 2003. Retrieved from Internet Oct. 29, 2004. <http://www.techonline.com/communicty/related_content/28747>.*

Reid, Shannon. "VMEbus Switched Serial Standard Ratified." Dot21 Real Time Systems. Jan. 21, 2003. Retrieved from Internet Oct. 29, 2004. <http://www.dot21rts.com/pressstuff/vxs_release/VXS_release_4.html>.*

Harris, Jeffrey M. "VXS offers switched serial fabric path." EETimes. Jul. 15, 2002. Retrieved from Internet Oct. 29, 2004. <http://www.eet.com/in_focus/embedded_systems/OEG20020715S0040>.*

Heckman, Melissa. "VITA 41—VXS Backplane Introduction." Bustronic Quarterly e-Newsletter. Apr. 2003. Retrieved from Internet Oct. 29, 2004. <http://www.bustronic.com/Q3/Q2_2003_1.html>.*

"Bustronic Releases VXS Switched Serial Backplanes." Bustronic. Mar. 17, 2004. Retrieved from Internet Oct. 29, 2004. <http://www.bustronic.com/release/040317.htm>.*

Moll, Justin. "Article—VME Backplanes & Accessories Macking Life Easy for Designers." Bustronic. Nov. 2002. Retrieved from Internet Nov. 1, 2004. <http://www.bustronic.com/release/articles/VME-Nov02.htm>.*

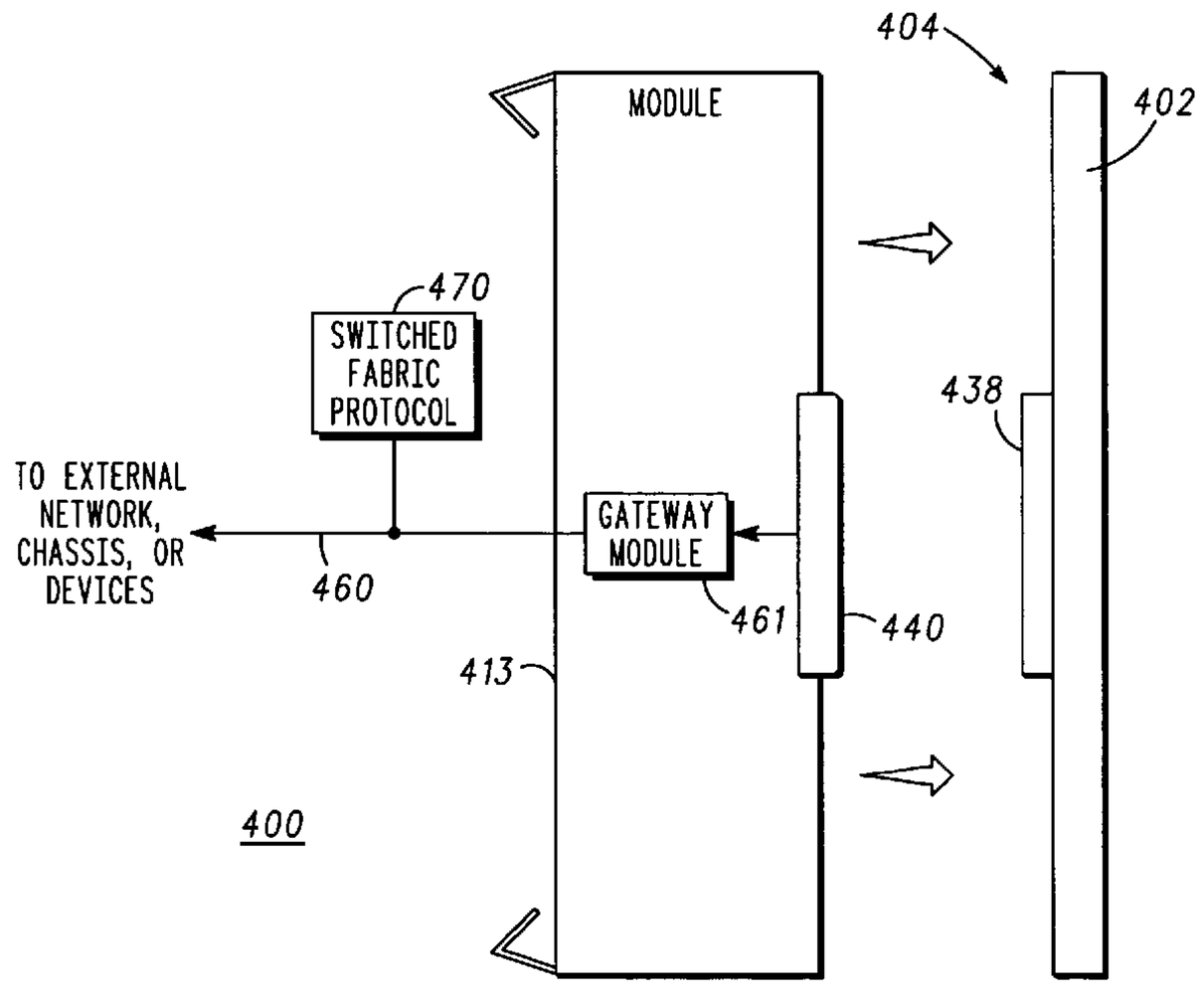
(Continued)

Primary Examiner—Khanh Dang
Assistant Examiner—Thomas J. Cleary
(74) *Attorney, Agent, or Firm*—Kevin D. Wills

(57) **ABSTRACT**

A VXS multi-service platform system **(100)** includes a VXS computer chassis **(103)**, a monolithic backplane **(102)** in the VXS computer chassis having a VMEbus network **(108)** on the monolithic backplane and a switched fabric **(110)** operating coincident with the VMEbus network on the monolithic backplane. A switched fabric link **(260)** extends the switched fabric external to the VXS computer chassis and the monolithic backplane.

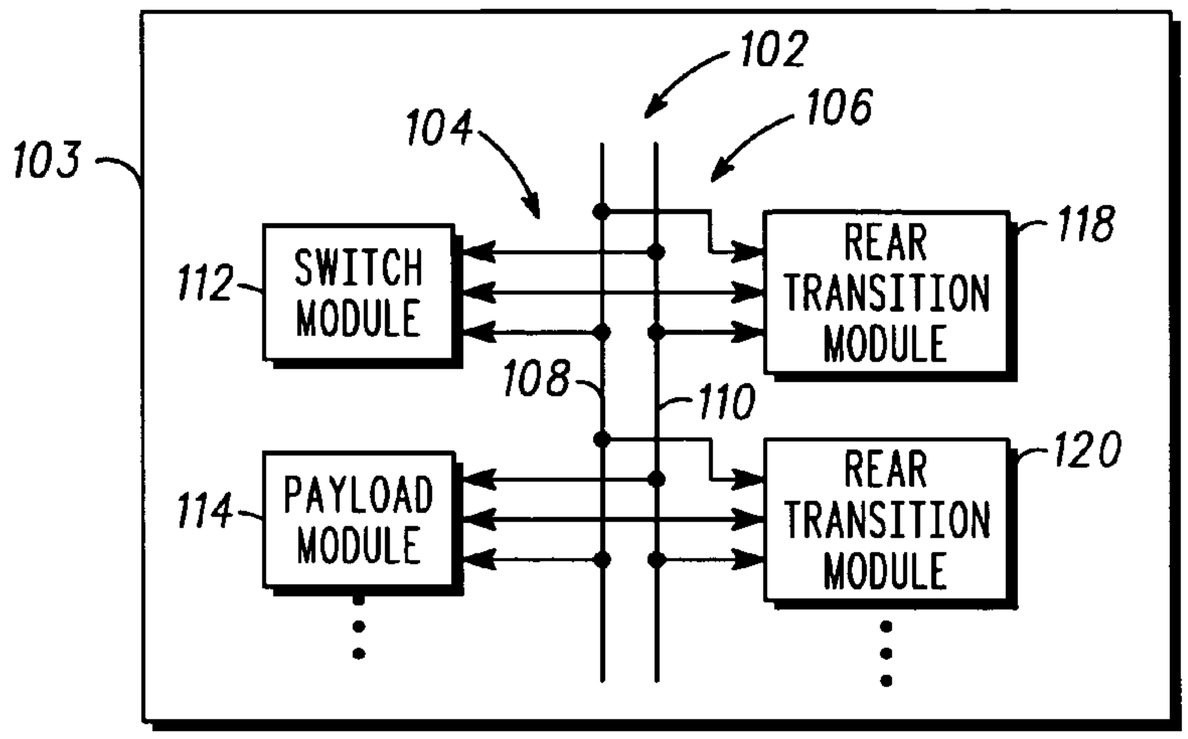
10 Claims, 3 Drawing Sheets



OTHER PUBLICATIONS

Harris, Jeffrey M. "The shocking truth about VXS." VMEbus Systems. Aug. 2003. Retrieved from Internet Oct. 29, 2004. <http://vmebus-systems.com/columns/VME%20Renaissance/current/index.shtml>.*
Munroe, Michael. "Backplane design moves to center stage." Planet Analog. Mar. 10, 2003. Retrieved from Internet Oct. 29, 2004. <http://www.planetanalog.com/showArticle.jhtml?articleID=18311760>.*
Sherman, Jon. "An Extension of the VITA 41.0 and VITA 41.2 Standards to Include 9U VME Boards." Raytheon. Jun. 13, 2003. Retrieved from Internet Nov. 1, 2004. <http://www.vita.com/vso/vso200307/23-Wed/1445-VITA%2041.2%209U%20extension.ppt>.*
Harris, Jeffrey M. "VXS: VMEbus Switched Serial." Motorola. Aug. 27, 2003. Retrieved from Internet Oct. 29, 2004. <http://web.archive.org/web/20030827184941/http://www.ll.mit.edu/HPEC/agendas/proc02/pdfs/6.2-harris.PDF>.*
Harris, Jeffrey M. "VME Renaissance." Motorola. Jan. 8, 2002.*
Tufford, Bob. "Motorola's MVME6100 The First VME Renaissance Masterpiece."*
"VITA 41.x—VXS: Adding High Performance Switch Fabrics to VME Based Systems." HTF125. Hybricon.*
Harris, Jeffrey M. "The VME Renaissance." White Paper. Motorola. Jan. 16, 2002.*
"VMEbus Switched Serial Standard Ratified." ForRelease.com. Jan. 20, 2003. Retrieved from Internet Nov. 1, 2004. <http://www.forrelease.com/D20030120/nym022.P2.01192003113307.18172.html>.*
"VITA 41.x VXS Switch Fabric Backplanes." Hybricon.*
"VSO Minutes Wednesday, Sep. 22, 2004." VMEbus International Trade Association. Sep. 22, 2004. Retrieved from Internet Nov. 1, 2004. <http://www.vita.com/vso/vso200409/vm200409.html>.*
"VITA-41 StarFabric Request for Working Group." Sep. 12, 2002.*
"VXS VMEbus Switched Serial Standard VITA 41.0-200x." Revision 1.6. Jan. 19, 2003.*
"VXS Serial RapidIO Protocol Layer Standard VITA 41.2-200x." Revision 1.7. Feb. 4, 2003.*
"VXS Infiniband Protocol Layer Standard VITA 41.1-200x." Revision 1.4. Aug. 7, 2002.*
"VITA-Open Systems." The VMEbus International Trade Association Webpage. Retrieved from Internet Nov. 1, 2004. <http://www.vita.com>.*
"VSO Draft Standards." The VMEbus International Trade Association Webpage. Nov. 26, 2003. Retrieved from Internet Nov. 1, 2004. <http://www.vita.com/draft_stds.html>.*
Rynearson, John. "VITA Brings Together Industry Experts to Further VXS and PMC Standards." PRWeb. Oct. 3, 2004. Retrieved from Internet Nov. 2, 2004. <http://www.prweb.com/releases/2004/10/prweb164023.htm>.*
"Hp hyperfabric hp hyperfabric2". Hewlett-Packard Company. 2002.*
"Oracle 9i Real Application Clusters Using HyperFabric on Hewlett-Packard Platforms". Technical White Paper. Hewlett-Packard Company. Jun. 2001.*

* cited by examiner



100

FIG. 1

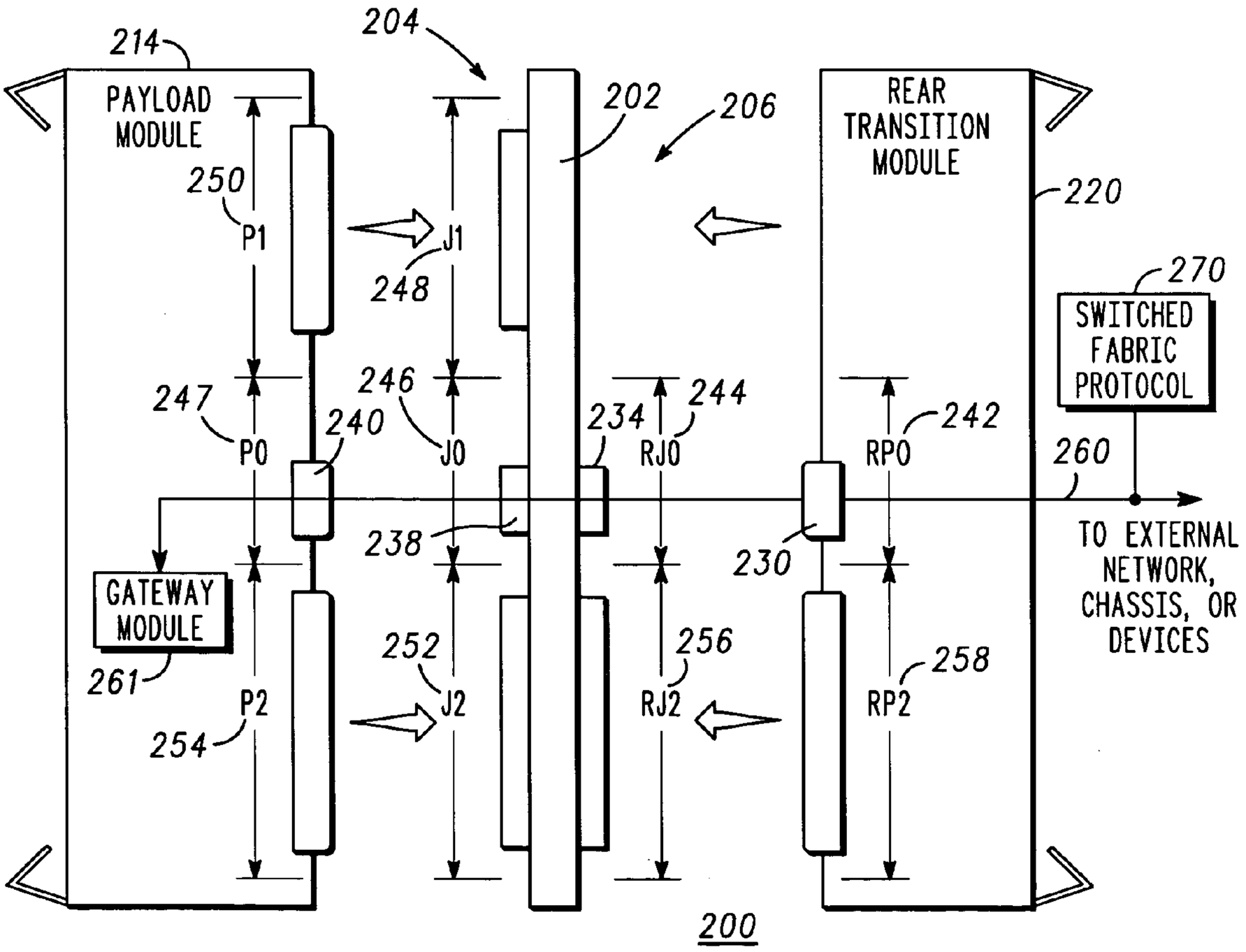


FIG. 2

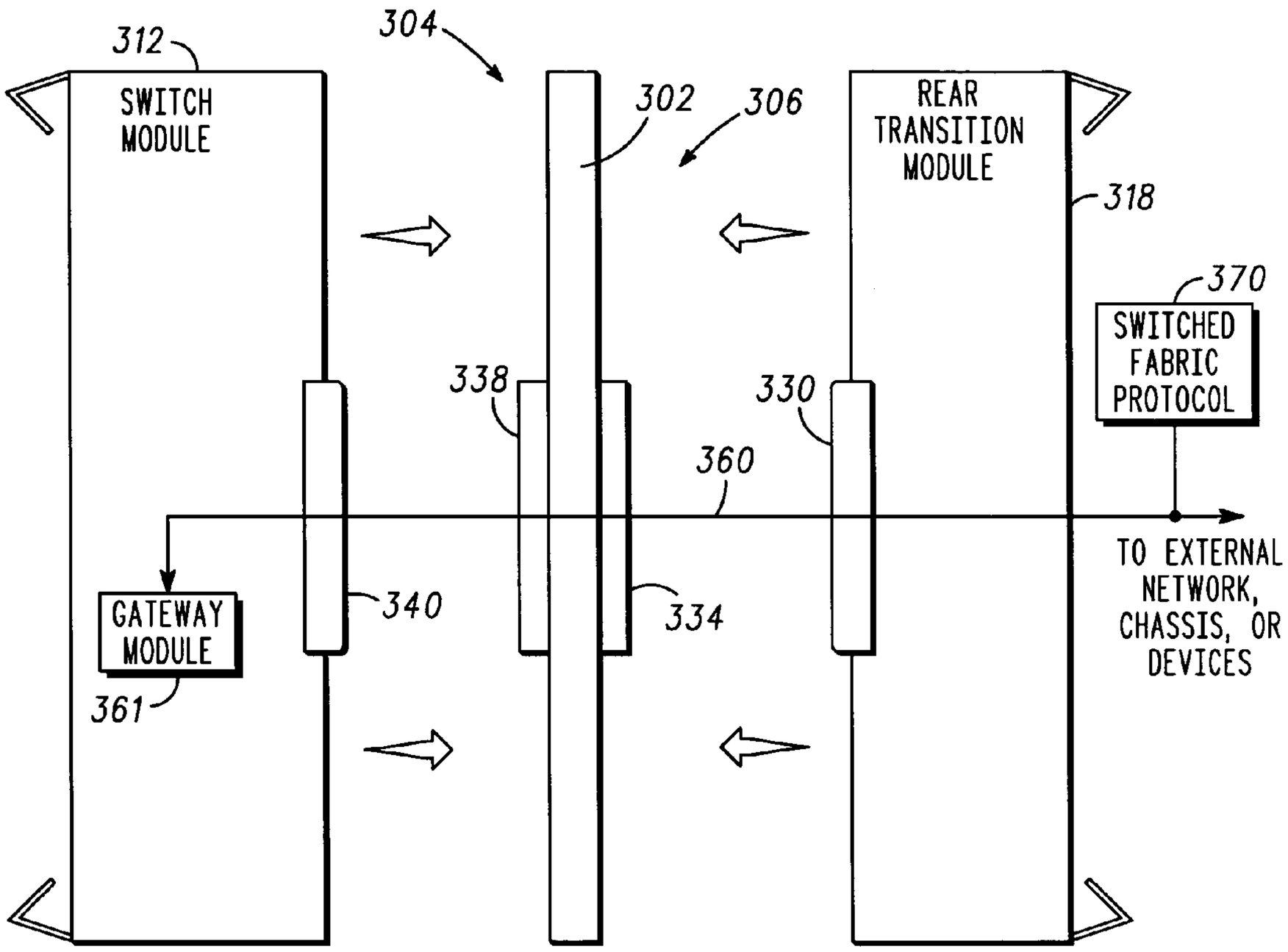

312
SWITCH MODULE
304
302
306
REAR TRANSITION MODULE
318
370
SWITCHED FABRIC PROTOCOL
338
330
360
340
334
GATEWAY MODULE
361
TO EXTERNAL NETWORK, CHASSIS, OR DEVICES
300

FIG. 3

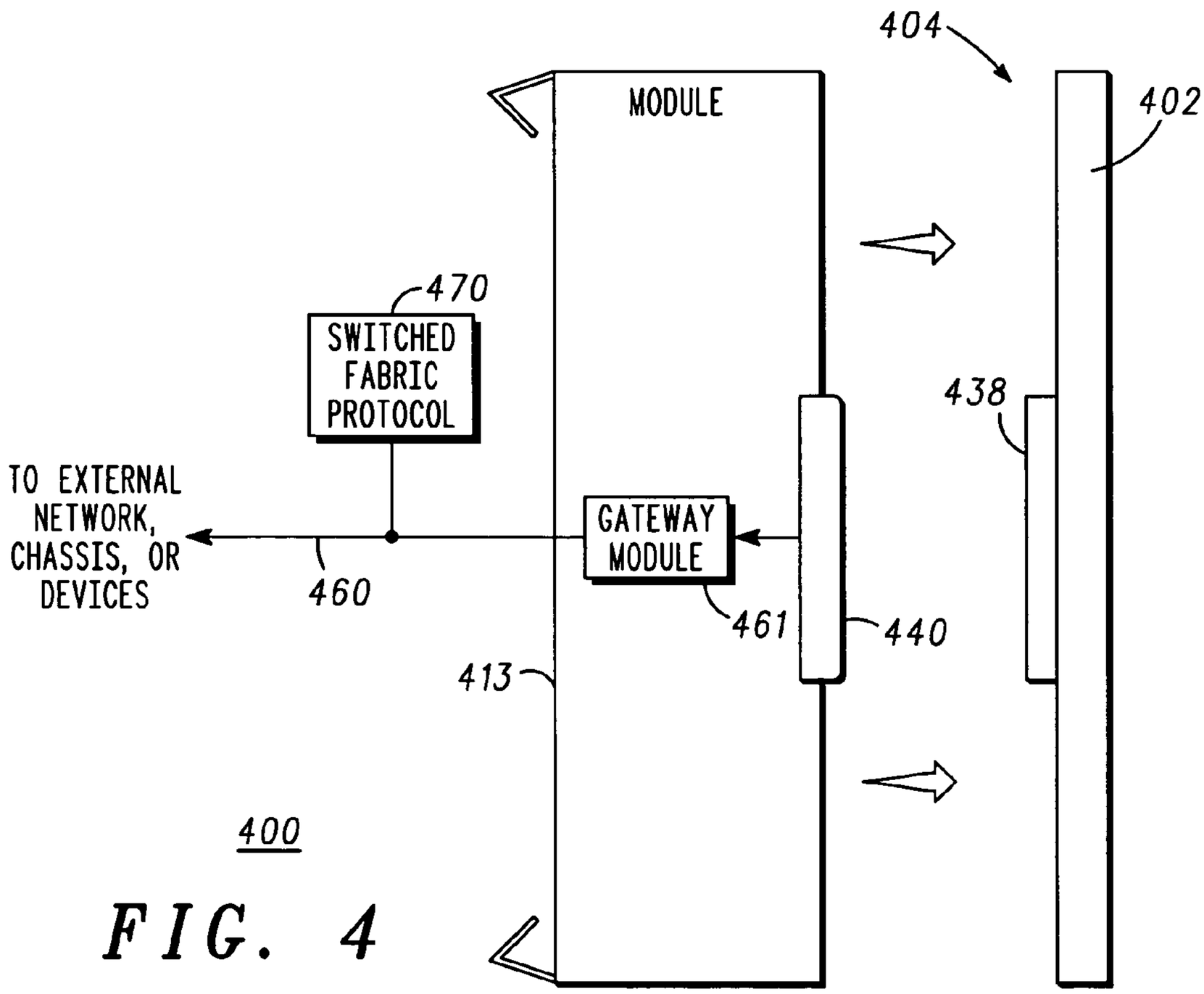

404
MODULE
402
470
SWITCHED FABRIC PROTOCOL
438
TO EXTERNAL NETWORK, CHASSIS, OR DEVICES
460
GATEWAY MODULE
461
440
413
400

FIG. 4

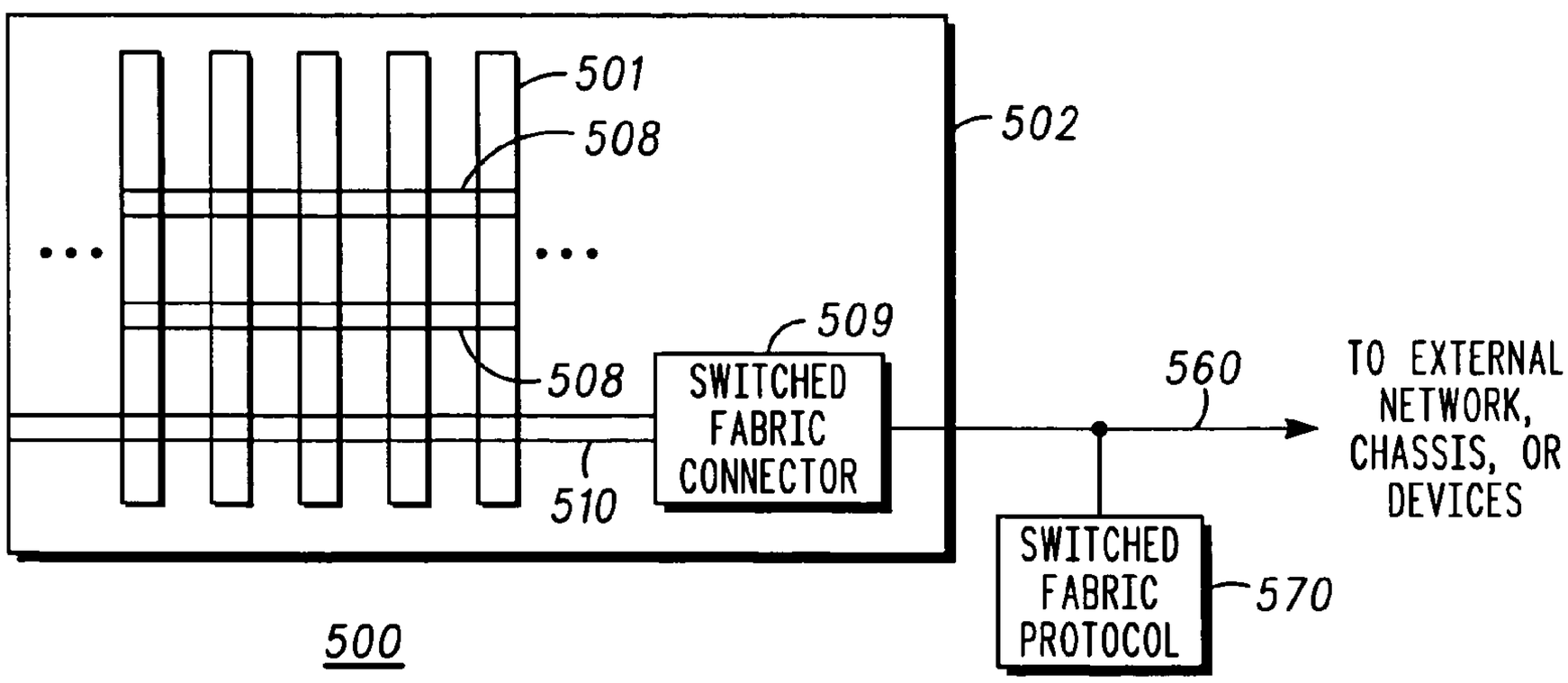

501
508
502
509
508
SWITCHED FABRIC CONNECTOR
560
TO EXTERNAL NETWORK, CHASSIS, OR DEVICES
510
SWITCHED FABRIC PROTOCOL
570
500

FIG. 5

VXS MULTI-SERVICE PLATFORM SYSTEM WITH EXTERNAL SWITCHED FABRIC LINK

BACKGROUND OF THE INVENTION

In current embedded computer platforms, such as VERSAmodule Eurocard (VMEbus) systems, the shared multi-drop bus can only be used to support one simultaneous communication between modules in the network. However, some applications have requirements for simultaneous high bandwidth transfers between modules in the VMEbus system that cannot be handled by the shared multi-drop architecture of VMEbus. It is desirable to configure current VMEbus systems to accommodate high-speed data transfers while maintaining the existing VMEbus network architecture. The VERSAmodule Eurocard (VMEbus) switched serial standard backplane (VXS) provides a parallel multi-drop bus on the same backplane as a high-speed switched fabric. The prior art has the disadvantage in that the switched fabric is limited to use in a single chassis on a single backplane.

Accordingly, there is a significant need for an apparatus and method that overcomes the deficiencies of the prior art outlined above.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawing:

FIG. **1** depicts a VXS multi-service platform system according to one embodiment of the invention;

FIG. **2** depicts a VXS multi-service platform system according to an embodiment of the invention;

FIG. **3** depicts a VXS multi-service platform system according to another embodiment of the invention;

FIG. **4** depicts a VXS multi-service platform system according to yet another embodiment of the invention; and

FIG. **5** depicts a VXS multi-service platform system according to still another embodiment of the invention.

It will be appreciated that for simplicity and clarity of illustration, elements shown in the drawing have not necessarily been drawn to scale. For example, the dimensions of some of the elements are exaggerated relative to each other. Further, where considered appropriate, reference numerals have been repeated among the Figures to indicate corresponding elements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description of exemplary embodiments of the invention, reference is made to the accompanying drawings, which illustrate specific exemplary embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, but other embodiments may be utilized and logical, mechanical, electrical and other changes may be made without departing from the scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims.

In the following description, numerous specific details are set forth to provide a thorough understanding of the invention. However, it is understood that the invention may be practiced without these specific details. In other instances,

well-known circuits, structures and techniques have not been shown in detail in order not to obscure the invention.

For clarity of explanation, the embodiments of the present invention are presented, in part, as comprising individual functional blocks. The functions represented by these blocks may be provided through the use of either shared or dedicated hardware, including, but not limited to, hardware capable of executing software. The present invention is not limited to implementation by any particular set of elements, and the description herein is merely representational of one embodiment.

FIG. **1** depicts a VXS multi-service platform system **100** according to one embodiment of the invention. A VXS multi-service platform system **100** can include one or more computer chassis, with software and any number of slots for inserting payload module **114**, switch module **112**, and rear transition modules **118**, **120**. Modules can add functionality to VXS multi-service platform system **100** through the addition of processors, memory, storage devices, device interfaces, network interfaces, and the like. In one embodiment a backplane connector is used for connecting modules placed in the slots. In an embodiment, VXS multi-service platform system **100** is an embedded, distributed processing computer system.

In an embodiment, VXS multi-service platform system **100** comprises an embedded-type computer system having a single chassis supporting a monolithic backplane **102** and further comprising individual slots. In this embodiment, monolithic backplane **102** includes a single backplane in a single VXS computer chassis **103**. In an embodiment, slots on the front portion **104** of the monolithic backplane **102** are coupled for receiving switch module **112** and payload module **114** that plug into the monolithic backplane **102**. In an embodiment, slots on the rear portion **106** of monolithic backplane **102** are coupled for receiving rear transition modules **118**, **120** that also plug into the monolithic backplane **102**. In an embodiment, each payload module and rear transition module can have a standardized form factor including physical dimensions, electrical connections, and the like as specified in an industry standard specification, for example VERSAmodule Eurocard (VMEbus), VXS, and the like, as described further below.

As an example of an embodiment, VXS multi-service platform system **100** can include VXS computer chassis **103** and one or more modules conforming to the VERSAmodule Eurocard (VMEbus) switched serial standard backplane (VXS) as set forth in VITA 41 promulgated by VMEbus International Trade Association (VITA), P.O. Box 19658, Fountain Hills, Ariz., 85269. VXS multi-service platform system **100** includes a packet switched network, known as a switched fabric **110** and a VMEbus network **108**, both located on monolithic backplane **102**. In other words, a VXS multi-service platform system **100** includes switched fabric **110** coincident with VMEbus network **108** on monolithic backplane **102**.

In an embodiment, VXS multi-service platform system **100** can be controlled by a platform controller (not shown for clarity), which can include a processor for processing algorithms stored in memory. Memory comprises control algorithms, and can include, but is not limited to, random access memory (RAM), read only memory (ROM), flash memory, electrically erasable programmable ROM (EEPROM), and the like. Memory can contain stored instructions, tables, data, and the like, to be utilized by a processor. Platform controller can be contained in one, or distributed

among two or more payload modules with communication among the various modules of VXS multi-service platform system **100**.

Switched fabric **110** allows all payload modules equipped to communicate with the switched fabric to be coupled to all other payload modules similarly equipped. Switched fabric **110** operating on monolithic backplane **102** can use a switch module **112** as a central switching hub with any number of payload modules **114** coupled to switch module **112**. Although FIG. **1** depicts switched fabric **110** as a bus for diagrammatic ease, switched fabric **110** may in fact be a star topology, mesh topology, and the like as known in the art for communicatively coupling switched fabrics. Switched fabric **110** can be based on a point-to-point, switched input/output (I/O) fabric, whereby cascaded switch devices interconnect end node devices. In an embodiment, switched fabric **110** supports data transfer at multi-gigabyte rates, for example data transfer in excess of two gigabytes per second. Monolithic backplane **102** can be implemented by using one or more of a plurality of switched fabric protocols, for example and without limitation, InfiniBand™, Serial RapidIO™, FibreChannel™, Ethernet™, PCI Express™, Universal Serial Bus (USB), Serial AT Attachment (Serial ATA), Serial Attached Small Computer System Interface (Serial Attached SCSI), and the like. Monolithic backplane **102** is not limited to the use of these switched fabric protocols and the use of any switched fabric protocol is within the scope of the invention.

VMEbus network **108** is a parallel multi-drop bus network that is known in the art. VMEbus network **108** is defined in the ANSI/VITA 1-1994 and ANSI/VITA 1.1-1997 standards, promulgated by the VMEbus International Trade Association (VITA), P.O. Box 19658, Fountain Hills, Ariz., 85269 (where ANSI stands for American National Standards Institute). In an embodiment of the invention, VMEbus network **108** can include VMEbus based protocols such as Single Cycle Transfer protocol (SCT), Block Transfer protocol (BLT), Multiplexed Block Transfer protocol (MBLT), Two Edge VMEbus protocol (2 eVME) and Two Edge Source Synchronous Transfer protocol (2eSST). VMEbus network **108** is not limited to the use of these VMEbus based protocols and other VMEbus based protocols are within the scope of the invention.

In an embodiment of the invention, VMEbus network **108** and switched fabric **110** operate concurrently within VXS multi-service platform system **100**. In one embodiment, switched fabric **110** operates in parallel with VMEbus network **108** in a VXS multi-service platform system **100**.

In an embodiment, payload module **114** and rear transition modules **118**, **120** can have a physical form factor including physical dimensions, electrical connections, and the like as set forth in the ANSI/VITA 1-1994 and ANSI/ITA 1.1-1997 standards.

In an embodiment, rear transition modules **118**, **120** can be used to interface VXS computer chassis **103** to external networks, chassis, devices, and the like. For example, rear transition modules **118**, **120** can be used to interface VXS computer chassis **103** to other chassis, other networks such as Ethernet, the Internet, and the like. Also, rear transition modules **118**, **120** can be used to interface VXS multi-service platform system **100** with devices such as storage drives, memory, processors, and the like.

In an embodiment, each rear transition module can have a corresponding payload module or corresponding switch module. For example, rear transition module **120** has corresponding payload module **114**. Also, rear transition module **118** has corresponding switch module **112**. In an embodiment, within VXS computer chassis **103**, rear transition module is substantially coplanar to its corresponding payload module or corresponding switch module. This can mean that rear transition module coupled to rear portion **106** of monolithic backplane **102** is substantially in the same plane as its corresponding payload module or corresponding switch module coupled to the front portion **104** of monolithic backplane **102**.

In an embodiment, rear transition module **120** can be coupled directly to switched fabric **110** and/or VMEbus network **108**. Also, rear transition module **120** can be coupled to corresponding payload module **114** through monolithic backplane **102**. In the embodiment shown, rear transition module **120** is shown coupled to VMEbus network **108**, switched fabric **110** and payload module **114**. This is not limiting of the invention as rear transition module **120** can be coupled to any combination of VMEbus network **108**, switched fabric **110** and payload module **114** and be within the scope of the invention.

In another embodiment, rear transition module **118** is coupled to corresponding switch module **112** through monolithic backplane **102**. Rear transition module **118** can also be coupled to VMEbus network **108** and/or switched fabric **110**. In the embodiment shown, rear transition module **118** is shown coupled to VMEbus network **108**, switched fabric **110** and switch module **112**. This is not limiting of the invention as rear transition module **118** can be coupled to any combination of VMEbus network **108**, switched fabric **110** and switch module **112** and be within the scope of the invention.

FIG. **2** depicts a VXS multi-service platform system **200** according to an embodiment of the invention. In an embodiment of the invention, monolithic backplane **202** and payload module **214** have a set of interlocking connectors designed to interlock with each other when payload module **214** is placed in a slot of VXS multi-service platform system **200**. Payload module **214** is coupled to interface with front portion **204** of monolithic backplane **202**. Mechanical and electrical specifications for a portion of these interlocking connectors can be found in the ANSI/VITA 1-1994 and ANSI/VITA 1.1-1997 and the VITA 41 standards cited above for VMEbus systems. For example, these standards define P0 mechanical envelope **247**, P1 mechanical envelope **250**, and P2 mechanical envelope **254** on payload module **214**. These standards further define corresponding J0 mechanical envelope **246**, J1 mechanical envelope **248**, and J2 mechanical envelope **252** on monolithic backplane **202**. Connectors in the P0/J0, P1/J1 and P2/J2 mechanical envelopes can interlock when payload module **214** is placed in a slot of VXS multi-service platform system **200**.

In an embodiment, payload module **214** has one portion of an interlocking connector in the P1 mechanical envelope **250** designed to interlock with its corresponding portion located in the J1 mechanical envelope **248** on monolithic backplane **202**. Also, payload module **214** can have an interlocking connector in the P2 mechanical envelope **254** designed to interlock with its corresponding portion located in the J2 mechanical envelope **252** on monolithic backplane **202**.

In an embodiment of the invention, connectors in the P1/J1 and P2/J2 mechanical envelopes are for coupling VMEbus network **108** to payload module **214**, while the connector in P0/J0 mechanical envelope is for coupling switched fabric **110** to payload module **214**. When payload module **214** is placed in a slot and coupled to monolithic backplane **202** via connectors in the P1/J1 and P2/J2 mechanical envelopes, the functionality of payload module

214 is added to VXS multi-service platform system 200 via VMEbus network 108. For example, processors, memory, storage devices, I/O elements, and the like, on payload module 214 are accessible by other payload modules in VXS multi-service platform system 200 and vice versa. When payload module 214 is placed in a slot and coupled to monolithic backplane 202 via a connector in the P0/J0 mechanical envelopes, the functionality of payload module 214 is added to VXS multi-service platform system 200 via switched fabric 110.

In this embodiment, payload module 214 can have payload module connector 240 in the P0 mechanical envelope 247 as defined in the VXS specification above. Monolithic backplane 202 can include payload connector 238 in the J0 mechanical envelope 246, where the payload module connector 240 and the payload connector 238 are designed to interface and interlock when payload module 214 is inserted into VXS multi-service platform system 200. In an embodiment, payload module connector 240 and payload connector 238 can be electrical, optical, radio frequency, biological, and the like, type connectors. In an embodiment, payload module connector 240 and payload connector 238 are designed for use in high-speed switched fabrics and are compatible with any of a plurality of switched fabric protocols 270 discussed above. Switched fabric 110 on monolithic backplane 202 operates using any of switched fabric protocols 270.

In an example of an embodiment of the invention, payload module connector 240 in the P0 mechanical envelope 247 and payload connector 238 in the J0 mechanical envelope 246 can be a Tyco MultiGig RT connector manufactured by the AMP division of Tyco Electronics, Harrisburg, Pa. The invention is not limited to the use of the Tyco RT connector, and any connector capable of handling data using any of the plurality of switched fabric network standards is encompassed within the invention.

In the embodiment depicted in FIG. 2, VXS multi-service platform system 200 can include rear transition module 220 coupled to interface with rear portion 206 of monolithic backplane 202. In an embodiment, rear transition module 220 is substantially coplanar with corresponding payload module 214.

In an embodiment of the invention, monolithic backplane 202 and rear transition module 220 have a set of interlocking connectors designed to interlock with each other when rear transition module 220 is placed in a slot of VXS multi-service platform system 200. Rear transition module 220 is coupled to interface with rear portion 206 of monolithic backplane 202. Mechanical and electrical specifications for a portion of these interlocking connectors can be found in the ANSI/VITA 1-1994 and ANSI/VITA 1.1-1997 and the VITA 41 standards cited above for VMEbus systems. For example, these standards define RP0 mechanical envelope 242, and RP2 mechanical envelope 258 on rear transition module 220. These standards further define corresponding RJ0 mechanical envelope 244, and RJ2 mechanical envelope 256 on monolithic backplane 202. Connectors in the RP0/RJ0 and RP2/RJ2 mechanical envelopes can interlock when rear transition module 220 is placed in a slot of rear portion 206 of monolithic backplane 202 of VXS multi-service platform system 200.

In an embodiment, rear transition module 220 can have an interlocking connector in the RP2 mechanical envelope 258 designed to interlock with its corresponding portion located in the RJ2 mechanical envelope 256 on the monolithic backplane 202. In an embodiment of the invention, connector in the RP2/RJ2 mechanical envelopes can be for coupling VMEbus network 108 to rear transition module 220 or for coupling corresponding payload module 214 to rear transition module 220.

When rear transition module 220 is placed in a slot and coupled to rear portion 206 of monolithic backplane 202 via connector in the P2/J2 mechanical envelope, the functionality of rear transition module 220 can be added to VXS multi-service platform system 200. This functionality can be added via directly connecting to VMEbus network 108 or by coupling to corresponding payload module 214. For example, I/O elements, and the like, on rear transition module 220 can be accessible by other payload modules in VXS multi-service platform system 200. These I/O elements can access external networks, chassis, devices, and the like, for example, external storage devices, external networks such as the Internet, other VXS computer chassis, and the like.

In another embodiment, the connector in RP0/RJ0 mechanical envelope can be for directly coupling switched fabric 110 to rear transition module 220 or for coupling corresponding payload module 214 to rear transition module 220. When rear transition module 220 is placed in a slot and coupled to rear portion 206 of monolithic backplane 202 via a connector in the RP0/RJ0 mechanical envelopes, the functionality of rear transition module 220 is added to VXS multi-service platform system 200. This functionality can be added via directly connecting to switched fabric 110 or by coupling to corresponding payload module 214. For example, I/O elements, and the like, on rear transition module 220 can be accessible by other payload modules in VXS multi-service platform system 200.

In this embodiment, rear transition module 220 can have connector 230 in the RP0 mechanical envelope 242. Rear portion 206 of monolithic backplane 202 can include corresponding connector 234 in the RJ0 mechanical envelope 244, where the connector 230 and the corresponding connector 234 are designed to interface and interlock when rear transition module 220 is inserted into VXS multi-service platform system 200. In an embodiment, connector 230 and corresponding connector 234 can be electrical, optical, radio frequency, biological, and the like, type connectors. In an embodiment, connector 230 and corresponding connector 234 are designed for use in high-speed switched fabrics and are compatible with any of a plurality of switched fabric protocols discussed above. In an example of an embodiment of the invention, connector 230 in the RP0 mechanical envelope 242 and corresponding connector 234 in the RJ0 mechanical envelope 244 can be a Tyco MultiGig RT connector manufactured by the AMP division of Tyco Electronics, Harrisburg, Pa. The invention is not limited to the use of the Tyco RT connector, and any connector capable of handling data using any of the plurality of switched fabric network standards is encompassed within the invention.

In an embodiment, switched fabric link 260 can extend switched fabric 110 from monolithic backplane 202, to networks, chassis, devices, and the like, external to VXS computer chassis 103. In the embodiment, shown, switched fabric link 260 extends from payload module 214 through monolithic backplane 202 to rear transition module 220. Switched fabric link 260 then exits VXS computer chassis 103 through rear transition module 220. In an embodiment, switched fabric link 260 can communicatively couple payload module 214 to rear transition module 220. Switched fabric link 260 can extend through payload module connector 240, payload connector 238, corresponding connector 234 and connector 230. Switched fabric link 260 can include

any type of medium to communicate data signals using switched fabric protocol **270**, for example, copper, optical, and the like.

In an embodiment, switched fabric link **260** can originate at gateway module **261** on payload module **214**. Gateway module **261** can be any combination of hardware, software, and the like that processes or creates data signals to or from switched fabric **110**. In an embodiment, gateway module **261** is also coupled to switched fabric **110**. Gateway module **261** can function to process incoming and outgoing data signals from VXS computer chassis **103** on switched fabric link **260** using switched fabric protocol **270**. In effect, gateway module **261** and switched fabric link **260** extend switched fabric **110** from a single VXS computer chassis **103** and monolithic backplane **202**, to any number of networks, chassis, devices, and the like, that are external to VXS computer chassis **103** and monolithic backplane **202**. In an embodiment, switched fabric **110** and switched fabric link **260** operate using the same switched fabric protocol. In another embodiment, switched fabric **110** communicates with at least one external network, external chassis, external device, and the like through switched fabric link **260** using switched fabric protocol **270**.

In the embodiment shown, only one switched fabric link **260** is shown. This is not limiting of the invention. Switched fabric link **260** can be divided into any number of switched fabric links exiting VXS multi-service platform system **200**. For example, although not shown in FIG. **2**, bridging circuitry can be provided on rear transition module **220** to bridge a copper switched fabric link **260**, for example, to any number of optical switched fabric links exiting VXS multi-service platform system **200**. In another embodiment, although not shown in FIG. **2**, switching circuitry can be provided on rear transition module **220** for a plurality of switched fabric links **260** exiting VXS multi-service platform system **200**.

FIG. **3** depicts a VXS multi-service platform system **300** according to another embodiment of the invention. In an embodiment of the invention, monolithic backplane **302** and switch module **312** have a set of interlocking connectors designed to interlock with each other when switch module **312** is placed in a slot of VXS multi-service platform system **300**. Switch module **312** is coupled to interface with front portion **304** of monolithic backplane **302**. Mechanical and electrical specifications for a portion of these interlocking connectors can be found in the ANSI/VITA 1-1994 and ANSI/VITA 1.1-1997 and the VITA 41 standards cited above for VMEbus systems.

Switch module **312** can have switch module connector **340** as defined in the VXS specification specified above. Monolithic backplane **302** can include backplane connector **338**, where the switch module connector **340** and backplane connector **338** are designed to interface and interlock when switch module **312** is inserted into VXS multi-service platform system **300**. In an embodiment, switch module connector **340** and backplane connector **338** can be electrical, optical, radio frequency, biological, and the like, type connectors. In an embodiment, switch module connector **340** and backplane connector **338** are designed for use in high-speed switched fabrics and are compatible with any of a plurality of switched fabric protocols **370** discussed above. Switched fabric **110** on monolithic backplane **302** operates using any of switched fabric protocols **370**.

In an example of an embodiment of the invention, switch module connector **340** and backplane connector **338** can be a Tyco MultiGig RT connector manufactured by the AMP division of Tyco Electronics, Harrisburg, Pa. The invention is not limited to the use of the Tyco RT connector, and any connector capable of handling data using any of the plurality of switched fabric network protocols is encompassed within the invention.

In the embodiment depicted in FIG. **3**, VXS multi-service platform system **300** can include rear transition module **318** coupled to interface with rear portion **306** of monolithic backplane **302**. In an embodiment, rear transition module **318** is substantially coplanar with corresponding switch module **312**.

In an embodiment of the invention, monolithic backplane **302** and rear transition module **318** have a set of interlocking connectors designed to interlock with each other when rear transition module **318** is placed in a slot of VXS multi-service platform system **300**. Rear transition module **318** is coupled to interface with rear portion **306** of monolithic backplane **302**. Mechanical and electrical specifications for a portion of these interlocking connectors can be found in the ANSI/VITA 1-1994 and ANSI/VITA 1.1-1997 and the VITA 41 standards cited above for VMEbus systems.

In an embodiment, rear transition module **318** can have connector **330**. Rear portion **306** of monolithic backplane **302** can include corresponding connector **334**, where the connector **330** and the corresponding connector **334** are designed to interface and interlock when rear transition module **318** is inserted into VXS multi-service platform system **300**. In an embodiment, connector **330** and corresponding connector **334** can be electrical, optical, radio frequency, biological, and the like, type connectors. In an embodiment, connector **330** and corresponding connector **334** are designed for use in high-speed switched fabrics and are compatible with any of a plurality of switched fabric protocols discussed above. In an example of an embodiment of the invention, connector **330** and corresponding connector **334** can be a Tyco MultiGig RT connector manufactured by the AMP division of Tyco Electronics, Harrisburg, Pa. The invention is not limited to the use of the Tyco RT connector, and any connector capable of handling data using any of the plurality of switched fabric network protocols is encompassed within the invention.

In an embodiment, the connector **330** and corresponding connector **334** can be for directly coupling switched fabric **110** to rear transition module **318** or for coupling corresponding switch module **312** to rear transition module **318**. When rear transition module **318** is placed in a slot and coupled to rear portion **306** of monolithic backplane **302**, the functionality of rear transition module **318** is added to VXS multi-service platform system **300**. This functionality can be added via directly connecting to switched fabric **110** or by coupling to corresponding switch module **312**. For example, I/O elements, and the like, on rear transition module **318** can be accessible by other payload modules and/or switch module **312** in VXS multi-service platform system **300**.

In an embodiment, switched fabric link **360** can extend switched fabric **110** from monolithic backplane **302**, to networks, chassis, devices, and the like, external to VXS computer chassis **103**. In the embodiment, shown, switched fabric link **360** extends from switch module **312** through monolithic backplane **302** to rear transition module **318**. Switched fabric link **360** then exits VXS computer chassis **103** through rear transition module **318**. In an embodiment, switched fabric link **360** can communicatively couple switch module **312** to rear transition module **318**. Switched fabric link **360** can extend through switch module connector **340**, backplane connector **338**, corresponding connector **334** and connector **330**. Switched fabric link **360** can include any

type of medium to communicate data signals using switched fabric protocol **370**, for example, copper, optical, and the like.

In an embodiment, switched fabric link **360** can originate at gateway module **361** on switch module **312**. Gateway module **361** can be any combination of hardware, software, and the like that processes or creates data signals to or from switched fabric **110**. In an embodiment, gateway module **361** is also coupled to switched fabric **110**. Gateway module **361** can function to process incoming and outgoing data signals from VXS computer chassis **103** on switched fabric link **360** using switched fabric protocol **370**. In effect, gateway module **361** and switched fabric link **360** extend switched fabric **110** from a single VXS computer chassis **103** and monolithic backplane **302**, to any number of networks, chassis, devices, and the like, that are external to VXS computer chassis **103** and monolithic backplane **302**. In an embodiment, switched fabric **110** and switched fabric link **360** operate using the same switched fabric protocol. In another embodiment, switched fabric **110** communicates with at least one external network, external chassis, external device, and the like through switched fabric link **360** using switched fabric protocol **370**.

In the embodiment shown, only one switched fabric link **360** is shown. This is not limiting of the invention. Switched fabric link **360** can be divided into any number of switched fabric links exiting VXS multi-service platform system **300**. For example, although not shown in FIG. **3**, bridging circuitry can be provided on rear transition module **318** to bridge a copper switched fabric link **360**, for example, to any number of optical switched fabric links exiting VXS multi-service platform system **300**. In another embodiment, although not shown in FIG. **3**, switching circuitry can be provided on rear transition module **318** for a plurality of switched fabric links **360** exiting VXS multi-service platform system **300**.

FIG. **4** depicts a VXS multi-service platform system **400** according to yet another embodiment of the invention. As shown in FIG. **4**, VXS multi-service platform system **400** can include module **413**, which can be one of a switch module or a payload module as described above. Module **413** can couple to front portion **404** of monolithic backplane **402** via one or more module connectors **440** and backplane connectors **438** analogous to those described above.

In an embodiment, module **413** can include switched fabric link **460**, which can extend switched fabric **110** from monolithic backplane **402**, to networks, chassis, devices, and the like, external to VXS computer chassis **103**. Switched fabric link **460** can include any type of medium to communicate data signals using switched fabric protocol **470**, for example, copper, optical, and the like.

In an embodiment, switched fabric link **460** can originate at gateway module **461** on module **413**. Gateway module **461** can be any combination of hardware, software, and the like that processes or creates data signals to or from switched fabric **110**. In an embodiment, gateway module **461** is also coupled to switched fabric **110**. Gateway module **461** can function to process incoming and outgoing data signals from VXS computer chassis **103** on switched fabric link **460** using switched fabric protocol **470**. In effect, gateway module **461** and switched fabric link **460** extend switched fabric **110** from a single VXS computer chassis **103** and monolithic backplane **402**, to any number of networks, chassis, devices, and the like, that are external to VXS computer chassis **103** and monolithic backplane **402**. In an embodiment, switched fabric **110** and switched fabric link **460** operate using the same switched fabric protocol. In another embodiment, switched fabric **110** communicates with at least one external network, external chassis, external device, and the like through switched fabric link **460** using switched fabric protocol **470**.

In the embodiment shown, only one switched fabric link **460** is shown. This is not limiting of the invention. Switched fabric link **460** can be divided into any number of switched fabric links exiting VXS multi-service platform system **400**. For example, although not shown in FIG. **4**, bridging circuitry can be provided on module **413** to bridge a copper switched fabric link **460**, for example, to any number of optical switched fabric links exiting VXS multi-service platform system **400**. In another embodiment, although not shown in FIG. **4**, switching circuitry can be provided on module **413** for a plurality of switched fabric links **460** exiting VXS multi-service platform system **400**.

FIG. **5** depicts a VXS multi-service platform system **500** according to still another embodiment of the invention. As shown in FIG. **4**, VXS multi-service platform system **500** can include monolithic backplane **502** having any number of slots **501** for inserting modules, such as switch modules, payload modules, rear transition modules, and the like as described above.

In an embodiment, each of slots **501** is coupled on monolithic backplane **502** by VMEbus network **508** and switched fabric **510**. In an embodiment, monolithic backplane **502** can further include switched fabric connector **509** coupled to interface with switched fabric **510**. In an example of an embodiment of the invention, switched fabric connector **509** can be a Tyco MultiGig RT connector manufactured by the AMP division of Tyco Electronics, Harrisburg, Pa. The invention is not limited to the use of the Tyco RT connector, and any connector capable of handling data using any of the plurality of switched fabric network protocols is encompassed within the invention.

In an embodiment, switched fabric connector **509** can be coupled to interface with a module placed in a slot **501** of VXS multi-service platform system **500**. In this embodiment, switched fabric link **560** can extend switched fabric **510**, through the module, to external networks, chassis, devices, and the like. Switched fabric connector **509** is coupled to extend switched fabric **510** to networks, chassis, devices, and the like, external to VXS multi-service platform system **500** and monolithic backplane **502**.

In another embodiment, switched fabric link **560** can be coupled directly to switched fabric connector **509** to extend switched fabric **510** outside of VXS multi-service platform system without passing through a module.

In an embodiment, switched fabric **510** and switched fabric link **560** operate using the same switched fabric protocol **570**. In another embodiment, switched fabric **510** communicates with at least one external network, external chassis, external device, and the like through switched fabric link **560** using switched fabric protocol **570**.

In the embodiment shown, only one switched fabric link **560** is shown. This is not limiting of the invention. Switched fabric link **560** can be divided into any number of switched fabric links exiting VXS multi-service platform system **500**. For example, although not shown in FIG. **5**, bridging circuitry can be provided to bridge a copper switched fabric link **560**, for example, to any number of optical switched fabric links exiting VXS multi-service platform system **500**. In another embodiment, although not shown in FIG. **5**, switching circuitry can be provided for a plurality of switched fabric links **560** exiting VXS multi-service platform system **500**.

While we have shown and described specific embodiments of the present invention, further modifications and improvements will occur to those skilled in the art. It is therefore, to be understood that appended claims are intended to cover all such modifications and changes as fall within the true spirit and scope of the invention.

What is claimed is:

1. A VXS multi-service platform system, comprising:

a VXS computer chassis;

a monolithic backplane in the VXS computer chassis;

a VMEbus network on the monolithic backplane;

a switched fabric operating coincident with the VNEbus network on the monolithic backplane; and

a switched fabric link, wherein the switched fabric link extends the switched fabric external to the VXS computer chassis and the monolithic backplane through at least one of a payload module and a rear transition module.

2. The VXS multi-service platform system of claim **1**, wherein the payload module is coupled to a front portion of the monolithic backplane, and wherein the rear transition module is coupled to a rear portion of the monolithic backplane, wherein the rear transition module is substantially coplanar with the payload module, wherein the switched fabric link extends from the payload module through the monolithic backplane to the rear transition module, and wherein the switched fabric link exits the VXS computer chassis through the rear transition module.

3. The VXS multi-service platform system of claim **1**, further comprising:

a switch module coupled to a front portion of the monolithic backplane, wherein the rear transition module coupled to a rear portion of the monolithic backplane, wherein the rear transition module is substantially coplanar with the switch module, wherein the switched fabric link extending from the switch module through the monolithic backplane to the rear transition module, and wherein the switched fabric link exits the VXS computer chassis through the rear transition module.

4. The VXS multi-service platform system of claim **1**, wherein the switched fabric link couples the VXS computer chassis and the monolithic backplane to at least one of an external network, external chassis and external device.

5. The VXS multi-service platform system of claim **1**, wherein the switched fabric communicates within the VXS computer chassis on the monolithic backplane using a switched fabric protocol, and wherein the switched fabric communicates with at least one of an external network, external chassis and external device through the switched fabric link using the switched fabric protocol.

6. A method, comprising:

providing a VXS computer chassis having a monolithic backplane;

operating a VMEbus network and a switched fabric coincident on the monolithic backplane; and

extending the switched fabric external to the VXS computer chassis and the monolithic backplane through at least one of a payload module and a rear transition module through a switched fabric link.

7. The method of claim **6**, further comprising:

coupling the payload module to a front portion of the monolithic backplane;

coupling the rear transition module to a rear portion of the monolithic backplane, wherein the rear transition module is substantially coplanar with the payload module;

extending the switched fabric link from the payload module through the monolithic backplane to the rear transition module; and

the switched fabric link exiting the VXS computer chassis through the rear transition module.

8. The method of claim **6**, further comprising:

coupling a switch module to a front portion of the monolithic backplane;

coupling the rear transition module to a rear portion of the monolithic backplane, wherein the rear transition module is substantially coplanar with the switch module;

extending the switched fabric link from the switch module through the monolithic backplane to the rear transition module; and

the switched fabric link exiting the VXS computer chassis through the rear transition module.

9. The method of claim **6**, wherein the switched fabric link couples the VXS computer chassis and the monolithic backplane to at least one of an external network, external chassis and external device.

10. The method of claim **6**, further comprising:

the switched fabric communicating within the VXS computer chassis on the monolithic backplane using a switched fabric protocol; and

the switched fabric communicating with at least one of an external network, external chassis and external device through the switched fabric link using the switched fabric protocol.

* * * * *